

WHAT IS CLAIMED IS:

- 1 1. A method for connecting component-side pad electrodes and
2 substrate-side pad electrodes when a surface-mount component is mounted onto
3 the substrate, wherein the component-side pad electrodes are formed on the
4 surface of the component opposed to a substrate, solder bumps are formed on the
5 component-side pad electrodes, and substrate-side pad electrodes are formed on
6 the surface of the substrate, the method comprising:
7 arranging the substrate-side pad electrodes inside a component-
8 corresponding region which corresponds to the plan view of the surface-mount
9 component;
10 setting the length of each of the substrate-side pad electrodes in the
11 direction substantially perpendicular to the outer edge of the component-
12 corresponding region larger than the length of the corresponding component-side
13 pad electrode in the direction substantially perpendicular to the outer edge of the
14 surface-mount component;
15 placing the surface-mount component on the substrate so that each of the
16 solder bumps are opposed to a predetermined substrate-side pad electrode; and
17 melting the solder bumps by heating to connect each of the component-
18 side pad electrodes to one of the substrate-side pad electrodes through the solder.
- 1 2. A method for connecting pad electrodes in accordance with
2 claim 1, wherein the width of each of said component-side pad electrodes and the
3 width of the solder bump on each of said component-side pad electrodes are larger
4 than the width of each of said substrate-side pad electrodes.
- 1 3. A method for inspecting the connection state of pad electrodes
2 comprising the steps of:
3 connecting the pad electrodes by a connection method in accordance with
4 claim 1;

5 detecting the shapes of the solder after each of said solder bumps has
6 been melted and flowed on one of said substrate-side pad electrodes by a
7 nondestructive inspection; and
8 making a pass/fail discrimination of the connection state between each of
9 the component-side pad electrodes and one of the substrate-side pad electrodes.

1 4. A method for inspecting the connection state of pad electrodes
2 comprising the steps of:
3 connecting the pad electrodes by a connection method in accordance with
4 claim 2;
5 detecting the shapes of the solder after each of said solder bumps has
6 been melted and flowed on one of said substrate-side pad electrodes by a
7 nondestructive inspection; and
8 making a pass/fail discrimination of the connection state between each of
9 the component-side pad electrodes and one of the substrate-side pad electrodes.

1 5. A method for inspecting the connection state of the pad electrodes
2 comprising the steps of:
3 connecting the pad electrodes by a connection method in accordance with
4 claim 1;
5 obtaining an X-ray transmission image by radiating X rays from the back
6 surface side of said substrate; and
7 detecting the shape of solder after each of said solder bumps has been
8 melted and flowed on one of said substrate-side pad electrodes, from the obtained
9 X-ray transmission image; and
10 making a pass/fail discrimination of the connection state between each of
11 the component-side pad electrodes and one of the substrate-side pad electrodes.

1 6. A method for inspecting the connection state of the pad electrodes
2 comprising the steps of:
3 connecting the pad electrodes by a connection method in accordance with
4 claim 2;
5 obtaining an X-ray transmission image by radiating X rays from the back
6 surface side of said substrate; and
7 detecting the shape of solder after each of said solder bumps has been
8 melted and flowed on one of said substrate-side pad electrodes, from the obtained
9 X-ray transmission image; and
10 making a pass/fail discrimination of the connection state between each of
11 the component-side pad electrodes and one of the substrate-side pad electrodes.

1 7. A connection structure comprising:
2 a substrate having a surface and substrate-side pad electrodes formed on
3 the substrate surface;
4 a surface-mount component having a surface and component-side pad
5 electrodes formed on the surface, the surface being opposed to the substrate with
6 each component-side pad electrode opposed to one of the substrate-side pad
7 electrodes;
8 wherein the substrate-side pad electrodes are arranged inside a
9 component-corresponding region, the length of each of the substrate-side pad
10 electrodes being larger than that of the corresponding component-side pad
11 electrode, and wherein each of the component-side pad electrodes is connected to
12 the corresponding substrate-side pad electrode by a solder which has flowed
13 between the component-side pad electrodes and the substrate-side pad electrodes
14 by melting of a solder bump.

1 8. A connection structure between the pad electrodes in accordance
2 with claim 7, wherein the width of each of said component-side pad electrodes is
3 set to be larger than the width of each of said substrate-side pad electrodes.

Figure 1 illustrates the steps of the proposed algorithm for finding a minimum spanning tree. The process starts with a graph with 6 nodes and 7 edges. The algorithm proceeds by selecting edges in increasing order of weight, ensuring that no cycles are formed. The steps are as follows:

- (a) Initial graph with 6 nodes and 7 edges.
- (b) Select edge (1,2) with weight 1.
- (c) Select edge (2,3) with weight 1.
- (d) Select edge (3,4) with weight 1.
- (e) Select edge (4,5) with weight 1.
- (f) Select edge (5,6) with weight 1.
- (g) Select edge (1,3) with weight 2.
- (h) Select edge (2,4) with weight 2.
- (i) Select edge (3,5) with weight 2.
- (j) Select edge (4,6) with weight 2.
- (k) Select edge (1,4) with weight 3.
- (l) Final minimum spanning tree with total weight 10.